# DRAFT

## EVALUATION OF POTENTIAL HEALTH EFFECTS OF EATING FISH FROM BLACK BUTTE RESERVOIR (GLENN AND TEHAMA COUNTIES): GUIDELINES FOR SPORT FISH CONSUMPTION

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## EVALUATION OF POTENTIAL HEALTH EFFECTS OF EATING FISH FROM BLACK BUTTE RESERVOIR (GLENN AND TEHAMA COUNTIES): GUIDELINES FOR SPORT FISH CONSUMPTION

**Pesticide and Environmental Toxicology Section**
**Office of Environmental Health Hazard Assessment**
**California Environmental Protection Agency**

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## FOREWORD

This report provides recommended guidelines for consumption of largemouth bass and channel catfish from Black Butte Reservoir (Glenn and Tehama Counties) as a result of findings of high levels of mercury in fish tested from Black Butte Reservoir. These recommendations are made to protect against possible adverse health effects from methylmercury as consumed from mercury-contaminated fish. The report provides background information and a description of the data and criteria used to develop the guidelines.

To protect public health in the period while this technical support document was being prepared for public comment, the County of Glenn Health Services Agency, Division of Environmental Health, and the County of Tehama Health Services, in consultation with the Office of Environmental Health Hazard Assessment, issued an interim public health advisory for fish from Black Butte Reservoir. This advisory is included in Appendix I. Once finalized, the advisory contained herein will become the final state advisory.

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## EXECUTIVE SUMMARY

The Office of Environmental Health Hazard Assessment (OEHHA) performed a study, "Prevalence of Selected Target Chemical Contaminants in Sport Fish from Two California Lakes: Public Health Designed Screening Study," (California Lakes Study) of chemical contamination in sport fish from Black Butte Reservoir. Sampling design for this study was limited by the screening nature of the study and the funding available. The results of that study are used in this evaluation of the potential health effects of consuming sport fish from Black Butte Reservoir. The goal of the health evaluation is to assess the likelihood and degree of exposure to chemical contaminants in fish from Black Butte Reservoir and to determine whether a potential exists for possible adverse effects from this exposure to sport fish consumers using this lake. The study data are used to determine the nature and extent of chemical contamination in sport fish from Black Butte Reservoir. A copy of this report is available at www.oehha.ca.gov.

Mercury, in the form of methylmercury, is identified as the chemical of concern for persons consuming sport fish from Black Butte Reservoir. Methylmercury is the primary form of mercury in fish to which humans are exposed; it causes adverse effects on the neurological system. Of particular concern are the developmental effects in fetuses exposed *in utero*. Consumption of contaminated sport fish is the primary exposure route for mercury exposure to humans. Exposure under different scenarios for the amount and frequency of fish consumption were evaluated for persons consuming fish caught from Black Butte. Exposures via consumption of largemouth bass and channel catfish could be well characterized because an adequate number of samples of these fish species were collected and analyzed. Exposures via consumption of carp and crappie could not be well characterized due to the small number of samples collected and analyzed for these species.

The health evaluation found that fishers consuming largemouth bass or channel catfish from Black Butte Reservoir are potentially exposed to levels of methylmercury above the reference level set by the U.S. Environmental Protection Agency (U.S. EPA).

A health evaluation for consumption of carp and crappie could not be done using the limited samples collected and analyzed. However, these species have similar feeding habits to channel catfish and similar mercury concentrations were found in all three species at Black Butte Reservoir. This suggests that methylmercury is accumulating in all three species and that exposures from consumption of carp and crappie are likely to be similar to those from consumption of channel catfish.

Based on the health evaluation, OEHHA recommends the following consumption guidelines for fish taken from Black Butte:

Due to the elevated level of mercury, pregnant women, nursing women and women who may soon become pregnant (the most sensitive population) should eat no more than one meal (eight ounces) per month of largemouth bass, channel catfish, carp and crappie. Mercury is a potent neurotoxin, so children and adults should also follow the same advice. Meal sizes may be adjusted to body weight as described on page 15 and Table 6.

## INTRODUCTION

OEHHA conducted a study to sample selected sport fish species and measure the levels of target chemicals in these fish from Black Butte Reservoir. This study was part of a cooperative agreement with the U.S. EPA in which two lakes in California were sampled. The objective of the study was to provide an initial database to determine whether additional sampling and health evaluation was warranted in either lake. Although the extent of the study in each lake was restricted by the funding available, it was possible to sample several species of popular sport fish from Black Butte Reservoir.

The Final Project Report (FPR), "Prevalence of Selected Target Chemical Contaminants in Sport Fish from Two California Lakes: Public Health Designed Screening Study" (Brodberg and Pollock, 1999) concluded that a health evaluation of the results was warranted for people eating largemouth bass and channel catfish from Black Butte Reservoir. This health evaluation is based on the potential levels of exposure to methylmercury by persons consuming typical sport fish caught from Black Butte Reservoir, and the associated potential health hazards. Nearly all fish (sport and commercial) contain mercury at a measurable level. While the measurements are made as total mercury, most of the mercury in fish is present as methylmercury, which is the most toxic form of mercury. The health risk from consumption of fish containing methylmercury depends on the concentration of methylmercury in the fish and the amount of fish being consumed.

OEHHA is the agency responsible for evaluating potential public health risks from chemical contamination of sport fish, and issuing advisories, when appropriate, for the State of California. OEHHA's authorities to conduct these activities are based on mandates in the California Health and Safety Code, Section 205 (protecting public health), and Section 207 (advising local health authorities). Fish advisories developed by OEHHA are published in the California Sport Fishing Regulations and California Sport Fish Consumption Advisories (OEHHA, 1999).

## BACKGROUND

Under the cooperative agreement, OEHHA and U.S. EPA jointly selected sites and fish species to be sampled and chemicals to be analyzed. Black Butte Reservoir was selected for this study due to a combination of characteristics. First, it is in the California Coast Range where mercury contamination had been observed in fish in similar lakes. Second, it is a more rural recreational facility operated by the U.S. Army Corps of Engineers, and third, it is a popular fishing site for Hmong fishers living nearby in the Central Valley (personal communication, Glenn County Health Department). The lake itself straddles Glenn and Tehama Counties and is also used for camping, boating, and hunting.

Four sport fish species were collected for analysis of chemical contaminants from Black Butte. The species collected and analyzed were largemouth bass, channel catfish, crappie, and carp. Fish were collected from three regions of the lake (see Figure 1): Burris Creek Arm, Stony Creek Arm, and Angler's Cove (the area including Fisherman's Cove and extending to the dam). Samples were collected on November 25, and December 4 and 5, 1997. Muscle tissue from individual fish was combined into composites for chemical analysis. One composite of carp and one crappie composite were prepared. Nine composites of largemouth bass (two from Angler's Cove, four from Stony Creek Arm, and three from Burris Creek Arm) were prepared. Eight composites of channel catfish (one from Angler's Cove, four from Stony Creek Arm, and three from Burris Creek Arm) were prepared. The average size, weight, and other characteristics of fish in these composites are shown in Table 1. The California Department of Fish and Game (DFG) Water Pollution Control Laboratory (WPCL) sampled fish and prepared composites. Fish sampling and sample preparation methods are described in more detail in the FPR (Brodberg and Pollock, 1999).

OEHHA and U.S. EPA jointly selected the chemical contaminants to be analyzed. The chemicals analyzed for this study included four metals, 35 organic compounds plus 46 polychlorinated biphenyl (PCB) congeners, and chlorinated dibenzodioxin and dibenzofuran (dioxins/furans) compounds that could potentially accumulate in fish in California lakes. The reason for including a broad spectrum of chemicals and fish species in the analysis was to screen for those chemicals and fish species that posed the greatest potential health concern. Using this method, future monitoring might be limited to specific species and fewer chemicals. DFG WPCL analyzed metals and organic compounds. The California Department of Toxic Substances Control Hazardous Materials Control Laboratory analyzed composite tissue samples for dioxins/furans and three coplanar PCB congeners. The chemicals analyzed and the analytical methods are described in more detail in the FPR (Brodberg and Pollock, 1999).

This study was designed to incorporate U.S. EPA (1995) guidance for sampling and analysis of fish potentially used for fish advisories. U.S. EPA (1995) recommended using screening values (SVs) to identify chemical contaminants in sport fish tissue at concentrations, which may be of human health concern for frequent consumers of sport fish. Specific SVs were established for this study to determine fish species and/or chemicals for which more detailed sampling and/or health evaluations should be conducted. A more detailed discussion of the SVs and a comparison between them and the chemical concentrations in the sport fish species sampled from Black Butte Reservoir is presented in the FPR (Brodberg and Pollock, 1999). The mean (i.e., average) chemical concentrations for chemicals of potential health concern in Black Butte fish are presented in Table 2. The average concentrations are used in this health evaluation because chemical concentrations in individual species of fish from different collection sites are similar. Fishers are likely to eat some fish of a specific species that have higher concentrations of a chemical and some with lower concentrations. It is reasonable to assume that a consumer’s exposure from several meals will be closer to the averaged concentration for a chemical than the lowest or highest concentration. Thus, the lakewide average (mean) chemical concentration of mercury in a fish species represents the typical catch and consumption exposure for consumers eating that species from the lake.

Mercury is the only chemical that exceeded the study SV; consequently it is the only chemical for which a health evaluation is warranted. As discussed in the FPR (Brodberg and Pollock, 1999), a health evaluation for consuming largemouth bass and channel catfish from Black Butte Reservoir is warranted due to the elevated mercury concentrations. This evaluation of the potential health risk of eating these fish is presented below. FPR concluded that the data available for carp and crappie were too limited (i.e., too few samples) to be representative of the population of these fish species at Black Butte Reservoir. These data are not sufficient without corroborating information for performing a health evaluation. However, qualitatively it is evident that mercury is also accumulating in carp and crappie. The level of accumulation in these species is similar to that in channel catfish. Consequently, the potential health concerns in carp and crappie are likely to be similar to those for channel catfish. Additional samples and mercury analyses for these species from Black Butte are needed to characterize the concentration of mercury in carp and crappie, to confirm the validity of the analytical results, and support a health evaluation.

## METHYLMERCURY TOXICOLOGY AND HAZARD IDENTIFICATION

Methylmercury is the predominant form of mercury in finfish. It usually accounts for >95 percent of the total mercury measured in fish tissue (May et al., 1987). Chemical analyses of mercury in fish tissue usually measure total mercury since it makes up close to 100 percent of the mercury present, and because the analysis for total mercury is less expensive than that for methylmercury. The resulting measure of total mercury in finfish is assumed to be 100 percent methylmercury for this risk assessment. Total mercury was analyzed in this study.

The potential toxic effects of methylmercury are well established due to an extensive database for human exposure at high levels as the result of several incidents of human poisoning. People in Japan consumed highly contaminated fish and shellfish from Minamata Bay and Niigata Prefecture (Harada, 1978, and Mishima, 1993). People in Iraq consumed bread made from seed-grain that had been treated with a methylmercury pesticide formulation (Bakir, et al., 1973). Some of the people exposed in these poisoning incidents eventually died. Clinical findings from these exposures showed that the nervous system was the main target of methylmercury in adults, children, and developing fetuses and that high exposures were lethal. Common signs of toxicity in adults were paresthesia (numbness and tingling), loss of sensation in the extremities, ataxia (loss of muscular coordination), auditory and visual sensory impairment, and mental disturbances (U.S. EPA, 1997; and the Agency for Toxic Substances and Disease Registry [ATSDR], 1999). Pathological changes in the nervous system were also observed. Some children exposed *in utero* were born with clinical symptoms to mothers who did not show clinical effects. This leads to the conclusion that the developing nervous system of fetuses is the most sensitive target of methylmercury toxicity. Effects observed in children exposed *in utero* included: delayed developmental milestones (e.g., walking and talking); irritability, paresthesia, altered muscle tone and tendon reflexes, incoordination, blindness, inability to speak, and seizures (IRIS, 1999).

Damage to the kidneys from acute and chronic methylmercury exposures has been observed in humans and in animal studies (ATSDR, 1999), however, the neurological endpoints are more sensitive to damage following methylmercury exposure than the kidney. Mice exposed to methylmercury chloride showed an increased incidence of tumors leading International Agency for Research on Cancer (IARC) (1993) to classify methylmercury compounds as possible human carcinogens (B2). Based on IARC's action, OEHHA administratively listed methylmercury compounds on the Proposition 65 list of carcinogens. However, a cancer potency factor has not been developed for methylmercury.

Methylmercury in food is almost completely absorbed from the gastrointestinal tract and is distributed in the blood throughout the body. Methylmercury crosses the placenta and the blood-brain barrier. In the brain, it is apparently metabolized to inorganic mercury. Methylmercury elimination is primarily in the bile, but it is also excreted in the feces, urine, and breast milk. The biological half-life of methylmercury in humans is about 70 days (Harada, 1995).

## DOSE-RESPONSE ASSESSMENT FOR METHYLMERCURY

In order to determine a reference level of methylmercury exposure, it is necessary to determine the lowest exposure dose that does not have an adverse effect on human health. In the case of methylmercury, the critical effect is developmental neurotoxicity and it is possible to estimate a dose without adverse effects from human epidemiological studies. U.S. EPA calculate an oral reference dose (RfD) for methylmercury (IRIS, 1999) using data collected in the aftermath of the Iraqi grain poisoning incident to estimate exposures associated with clinical developmental effects in children. U.S. EPA describes an RfD as an estimate of a daily exposure level to humans that is likely to be without an appreciable risk of deleterious effects during a lifetime. RfD's are established for non-cancer health effects for which it is assumed that there are no adverse health effects below some threshold of exposure. RfDs are established to include sensitive subgroups in the human population. Exposure to a level above the RfD does not mean that adverse effects will occur.

ATSDR used data from a study in the Seychelles Islands to estimate a no-effect level for methylmercury (ATSDR, 1999). This population is chronically exposed to methylmercury in the fish they consume. ATSDR calculated a minimal risk level (MRL) for methylmercury exposure using the results of tests of neurological effects in exposed children. ATSDR describes an MRL as "an estimate of daily human exposure to a dose of chemical that is likely to be without an appreciable risk of adverse noncancerous effects over a specified duration of exposure." MRLs are established below levels that might cause adverse effects in the people most sensitive to a chemical-induced effect. Exposure to a level above the MRL does not mean that adverse effects will occur. These studies and derivation of dose-response values from them are discussed below. There are other human studies of the effects of methylmercury but thus far these two documents have provided the most reasonable descriptions of the dose-response assessment and calculation of reference levels.

U.S. EPA RfD

U.S. EPA used data from a study by Marsh et al. (1987) of 81 mother infant pairs from the Iraqi poisoning as the most appropriate data set to calculate an RfD. U.S. EPA focused on the Iraqi data partly because results from the Seychelles and Faroes Islands studies were not readily available and had not been thoroughly evaluated at the time. The data from this study included clinical neurological signs (e.g., cerebral palsy, changes in muscle tone and deep tendon reflexes) and observations of delayed developmental milestones (i.e., not walking by 18 months or talking by 24 months) in children exposed *in utero*. This was a retrospective study so exposure doses could not be measured directly. The mother's dose of methylmercury was estimated using total mercury concentrations in maternal hair taken from selected regions of the scalp. Mercury concentrations in maternal hair ranged from 1 to 674 parts per million (ppm). Mercury concentrations in maternal hair were correlated with the clinical effects in offspring to establish dose groupings. A benchmark dose method was used to fit a mathematical dose-response model to the dose-response data. The benchmark dose estimate was rounded to 11 ppm (mg/kg) in hair. The benchmark dose is considered roughly equivalent to a threshold level and is viewed as a conservative estimate of the traditional no-observed-adverse-effect-level (NOAEL) used for non cancer effects. The benchmark dose method calculated the dose associated with "extra risk." The 95 percent lower bound on the dose at the 10 percent extra risk effect level was calculated using a quantal Weibull curve fitting model (U.S. EPA, 1997; IRIS, 1999).

A ratio of 250:1 (μg mercury/mg in hair: μg mercury/L of blood) was used to calculate the level of mercury in blood corresponding to the level in hair. At 11 ppm this is 44 μg mercury/L blood. This was the initial step in calculating the average daily exposure for mothers at the benchmark dose level. A standard physiological and pharmacokinetic model was used to calculate the corresponding average daily dietary intake of mercury by mothers during pregnancy. This calculation assumes steady state conditions and first order kinetics, and uses the following parameters: mercury concentration in blood is 44 μg/L; the elimination constant is 0.014 days$^{-1}$; blood volume of a 60 kg woman is 5 L; and the absorption factor for mercury is 0.95 (unitless) from the diet and 0.05 into the blood. The resulting daily dietary intake is 1.1 μg/kg-day (U.S. EPA, 1997; IRIS, 1999).

$$\text{daily dietary intake} = \frac{(44\ m\text{g/L})(0.014\ \text{days}^{-1})(5\text{L})}{(0.95)(0.05)(60\ \text{kg Body Weight})}$$

A ten-fold composite uncertainty factor for variation in the human hair to blood ratio for mercury, variation in the half-life of mercury, the lack of a two-generation study, and the lack of data on possible sequelae developing later in life (e.g., adult paresthesia), a longer duration of exposure was applied to the daily dietary exposure dose to derive a RfD. The final methylmercury RfD calculated by U.S. EPA is 1x10$^{-4}$ mg/kg-day to protect children from exposure to methylmercury during gestation (U.S. EPA, 1997; IRIS, 1999). U.S. EPA suggests that this RfD be used for the adult population as well because of uncertainty as to whether the threshold for adult paresthesia from chronic exposure to methylmercury was observable in the Iraqi study.

ATSDR MRL

Two recent independent studies of health effects from methylmercury exposure have been conducted in the Seychelles and Faroe Islands. The levels of methylmercury exposure from fish consumption in the Seychelles study are more typical of United States fish consumers. The levels of exposure in the Faroe Islands are similar to the Seychelles but may be more variable as a result of consumption of whale meat containing high levels of methylmercury. Results of the Faroe study demonstrate an adverse neurological effect in children exposed *in utero* (Grandjean et al., 1997), but the Seychelles study did not show an adverse effect at 66 months of age (Davidson et al., 1998). ATSDR used the Seychelles study to calculate an MRL for methylmercury based on determination of a NOAEL for the most sensitive subpopulation, children exposed *in utero*. ATSDR determined that the Seychelles study was better for developing the MRL because (a) the subjects consumed a large quantity (typically 12 fish meals per week) of a variety of ocean fish containing mercury, (b) the range of mercury concentration in these fish (0.004-0.75 ppm) was comparable to that in fish available to the United States population, (c) the relatively clean environment reduces the possibility that other environmental chemical exposures will confound the results, and (d) the population was literate, cooperative, and generally healthy, with low levels of both maternal alcohol consumption and tobacco use.

ATSDR used testing results at 66 months of age by Davidson et al. (1998) for 711 mother-infant pairs from the Seychelles Islands to calculate an MRL. Children in this study were exposed during gestation and also after birth through breast milk and consumption of fish. Children in the Seychelles were evaluated using age-appropriate neurodevelopmental tests at 6.5, 19, 29 and 66 months, and they are currently being tested at eight years of age. At 66 months, the test battery administered was designed to assess global functioning for multiple developmental domains including general cognition, language ability, reading and math abilities, visual-spatial ability, and social and adaptive behavior. The results of the 66 month tests showed no adverse effects (i.e. could be used to determine the NOAEL) that could be attributed to methylmercury exposure from maternal fish consumption. A small decrease in subjectively measured activity levels noted in boys in the 29-month observations was not apparent at 66 months (ATSDR, 1999).

Maternal exposures in the Seychelles studies were not measured directly but were estimated from maternal hair levels during pregnancy. Maternal hair levels ranged from 0.5-26.7 ppm with a mean of 6.8 ppm for mothers in the 66-month cohort. Children's hair levels determined in the 66-month cohort ranged from 0.9-25.8 ppm with a mean of 6.5 ppm. Because no adverse effects were observed in the 66-month cohort, the mean maternal hair concentration (15.3 ppm) in the group with the highest exposure in this cohort was considered a NOAEL (ATSDR, 1999). As in the U.S. EPA calculations, a hair:blood ratio of 250:1 was used to transform this hair concentration into a mercury concentration in blood of 0.061 mg/L. The same physiological based pharmacokinetic equation was used to convert this blood level to a daily intake, but some of the parameters differed from those used by U.S. EPA. In this regard, ATSDR used the following parameters: mercury concentration in blood is 61 ug/L; the elimination constant is 0.014 $days^{-1}$; blood volume of a 60 kg woman is 4.2 L; and the absorption factor for mercury is 0.95 (unitless) in the diet and 0.05 into the blood. Applying this model yields a NOAEL of $1.3x10^{-3}$ mg/kg/day. ATSDR applied modifying a factor of three to account for human pharmacokinetic and pharmacodynamic variability and a factor 1.5 to account for domain specific negative effects seen in a different test battery used in the Faroe study but not observed in the Seychelles studies (i.e., total modifying factor of 4.5). The final methylmercury MRL calculated by ATSDR is $3x10^{-4}$ mg/kg-day which is intended to protect the fetus exposed to methylmercury during gestation (ATSDR, 1999).

CHOICE OF REFERENCE LEVEL

Two measures of maternal hair levels (11 and 15.3 ppm mercury) have been derived from different studies and used by different agencies to represent a NOAEL. The relatively small difference between these two values shows a consistent identification of the dose-effect level for methylmercury. These dose levels were modeled to very similar daily dietary intake levels (1.1 and 1.3 mg/kg/day, respectively) and not too dissimilar reference exposure values (1 and $3x10^{-4}$ mg/kg/day). The three-fold difference between these final reference values is actually greater than the differences between the NOAELs. The greater difference in the final reference values is the result of the application of different uncertainty or modifying factors to calculate the daily dietary intake levels. The scientific evidence from these studies suggests that exposures resulting in maternal hair levels of less than or equal to about 11 to 15 ppm are not damaging to the developing fetus. However, it should be noted that the Faroe study suggests some effects may occur at less than a 10 ppm delivered dose (Grandjean et al., 1997). Other human studies are being conducted that might yield additional information on the lowest observed effect level of methylmercury exposure in humans.

OEHHA is evaluating the derivation of the U.S. EPA RfD and ATSDR MRL and the scientific strengths and weaknesses of the studies and assumptions used to calculate these values. Until this evaluation is complete, OEHHA will use the slightly more health protective U.S. EPA RfD of $1x10^{-4}$ mg/kg/day for risk assessments of methylmercury exposure via sport fish consumption.

## EXPOSURE ASSESSMENT OF EATING SPORT FISH FROM BLACK BUTTE RESERVOIR

The exposure assessment of eating sport fish from Black Butte Reservoir estimates exposures currently experienced or anticipated under different conditions for sport fish consumers eating fish species from the reservoir. The chemical concentrations reported in the FPR are used as representative of the nature and extent of chemical contamination in sport fish species from the reservoir. Mean concentrations are used to represent the central tendency (average) of exposure for the population in question. Methylmercury was identified in the FPR as the chemical of concern for persons consuming sport fish from Black Butte Reservoir. In the United States, the primary route of exposure to methylmercury for most of the population is via consumption of finfish (U.S. EPA, 1997). This is especially true for sport fish consumers. The consumption of sport fish species from Black Butte Reservoir will be the only path of methylmercury exposure considered in this exposure assessment. The exposure assessment will be applicable to local consumers of fish from Black Butte Reservoir and other persons who eat fish caught in the lake.

Different exposure scenarios for the amount and frequency of fish consumption are used in the exposure assessment to calculate likely exposure for various segments of the population annually consuming fish caught from the reservoir. Consumption rates determined for a wide demographic of fishers in Santa Monica Bay will serve as a model for fish consumption in other water bodies in California including Black Butte Reservoir (Gassel, 1998). Consumption rates corresponding to three different segments of the population of fishers catching and consuming sport fish were selected for this exposure assessment: a median consumption rate; an average rate; and high end ($90^{th}$ percentile) consumption rate. The median is the consumption rate representing the $50^{th}$ percentile in any study. An equal number of fish consumers in the study population consumed fish at more than this rate, and an equal number consumed fish at less than this rate. The reported median from the Santa Monica Bay study is 21 g/day ($2.1 \times 10^{-2}$ kg/day) (Southern California Coastal Water Research Project (SCCWRP) and MBC Applied Environmental Sciences, 1994; and Allen et al., 1996). In practical terms, this is equivalent to consuming less than three standard (eight ounce) meals per month of sport fish from Black Butte Reservoir during a year. Fishers consuming at the median are exposed at a relatively low level. The mean represents the mathematical average consumption rate. The reported mean from the Santa Monica Bay study is 50 g/day ($5.0 \times 10^{-2}$ kg/day) (SCCWRP and MBC, 1994; and Allen et al., 1996) which corresponds too less than seven standard meals per month of fish. This is representative of an average exposure. High-end consumers are viewed as those between the $90^{th}$ and $99.9^{th}$ percentile. The $90^{th}$ percentile was chosen in this case because the exposure assessment and risk characterization are based on consumers eating a single species at this rate from only this location. This is a conservative assumption because fishers are more likely to eat meals of different fish species from different locations during a year. Using a higher percentile for a single species assessment would lead to unrealistic exposure estimates based on few actual consumers in the extreme tail of the population distribution. The reported $90^{th}$ percentile from Santa Monica Bay is 107 g/day ($10.7 \times 10^{-2}$ kg/day) (SCCWRP and MBC, 1994; and Allen et al., 1996) which is equivalent to about 14 meals per month annually. This rate will be used to represent high-end (e.g., subsistence) consumers in the exposure assessment. These scenarios considered together characterize a reasonable range of consumption for the population fishing at the reservoir.

The concentrations of methylmercury used in the exposure assessment are based on the average (i.e., mean) concentration measured in the raw fish tissue as it was prepared for compositing. Largemouth bass, crappie, and carp tissues were all prepared with the skin on. Channel catfish tissues were prepared with the skin off. The average concentrations of mercury in the fish species sampled from Black Butte Reservoir were 700 parts per billion (ppb) for largemouth bass and 400 ppb for channel catfish (see Table 2).

The average concentrations measured in largemouth bass were based on nine composites each containing three fish. These composites represent a full size-range of largemouth bass from the lake: two composites were made of large fish (>500 mm in length); two composites were made of medium-sized fish (370-499 mm in length); and five composites were made of small fish at or over the legal size limit (see Table 1). These composites reflect the abundance of different size classes of largemouth bass during field collection so these samples are representative of what fishers are expected to catch and consume. The resulting mercury concentrations depart somewhat from a normal distribution. This is evident from the difference between the mean mercury concentration (700 ppb), the median concentration (530 ppb), and the geometric mean concentration (628 ppb) (see Table 3). This shift in the mean from the center of the distribution is due to the statistical effect that the higher mercury concentrations in the composites made of large-sized bass have on the computed mean. The average mercury concentration in this case is still a good measure of central tendency for mercury concentrations in bass because it will be representative of possible infrequent exposures to high concentrations (>1 ppm) from large fish. The average mercury concentration in largemouth bass will be used for estimating exposures of fishers catching and consuming this species from Black Butte Reservoir.

The average concentrations in channel catfish were based on eight composites, each containing four fish. Four of these composites were made of large-sized fish (>500 mm in length) and four were made of medium-sized fish (see Table 1). Smaller catfish were not evident in the field collections, so these samples are representative of what fishers are expected to catch and consume. Mercury concentrations in channel catfish are normally distributed. The mean mercury concentration (400 ppb), median concentration (380 ppb), and geometric mean concentration (398 ppb) are nearly the same (Table 3). Therefore, the mean should be a good representation of central tendency for methylmercury concentrations in channel catfish, and it will be used to represent typical methylmercury levels in this species to estimate exposures for fishers catching and consuming this channel catfish from Black Butte Reservoir.

Table 2 also gives values for the mercury concentrations in crappie (340 ppb) and carp (300 ppb). Only one composite was made for each of these species. These are not enough samples to be able to judge whether these concentrations are representative of the populations of these species in Black Butte Reservoir. The fact that these concentrations are similar to those in channel catfish suggests that methylmercury does accumulate in these fish species in this lake. This is not surprising since the feeding habits of channel catfish overlap those of carp and crappie. Although more samples of carp and crappie should be collected and analyzed, these similar mercury concentrations suggest the mercury level in these populations will be similar to that found in channel catfish. In contrast, largemouth bass have a more piscivorous feeding habit as is evident from the greater bioaccumulation of mercury in this fish species.

Human exposure estimates are calculated on a body weight basis so some reasonable assumption must be made about a typical fish consumer. Since the sensitive endpoint for methylmercury exposure is the nervous system in the developing fetus during gestation, the typical consumer whose methylmercury exposure is being modeled is a pregnant woman. A body weight of 65 kg was used in the exposure assessment to represent the body weight of pregnant women.

The formula for calculating the daily human exposure to methylmercury from fish consumption is shown below. In addition, the calculated daily exposures at different consumption levels for the mean mercury levels in Black Butte sport fish are shown in Table 4.

$$\text{mg Methylmercury/kg BW - day} = \frac{\text{(mg Methylmercury/kg Fish)(kg Fish/day)}}{\text{kg Body Weight}}$$

Where:

BW = body weight

## POTENTIAL HEALTH HAZARD OF EATING SPORT FISH FROM BLACK BUTTE RESERVOIR

The potential health hazard of eating sport fish from Black Butte Reservoir depends on whether an individual's exposure level is greater or less than the reference level at which adverse effects are unlikely. In the case of methylmercury, the effect of concern is damage to the developing nervous system in the fetus, and the reference level chosen for this health evaluation is the U.S. EPA RfD of $1 \times 10^{-4}$ mg/kg/day. When the estimated exposure level is less than the reference level, there is little risk of adverse health effects to the population in question from this chemical exposure. This comparison of estimated exposure to the reference level is expressed as a ratio called the hazard quotient or hazard index (HI). Exposures at HIs greater than "one" do not mean that adverse effects will occur. When the estimated exposure is more than the reference level, there is increasing risk of health effects in the exposed population, and when the exposure is a multiple of the reference level there is greater concern. Table 4 also shows HIs for methylmercury for consuming sport fish species from Black Butte Reservoir at different consumption rates.

HIs for largemouth bass and channel catfish are all greater than the value of one. Even the low consumption scenario results in an exposure greater than twice the methylmercury reference level for consumers of largemouth bass. Moderate consumption results in an exposure greater than five times the reference level and the high consumption scenario leads to an exposure from largemouth bass consumption 12 times the reference level. HI for the low consumption scenario is slightly above one for consumers of channel catfish. Moderate and high consumption of channel catfish leads to exposures three and almost seven times the reference level for methylmercury.

## RISK CHARACTERIZATION OF EATING SPORT FISH FROM BLACK BUTTE RESERVOIR

HIs calculated for largemouth bass and channel catfish (see Table 4) are based on multiple composites of each of these species. These are adequate samples for human health evaluation because the sample size is large enough to be reasonably sure that the measured levels are accurate representations of the true levels in these fish populations. The risks of consuming largemouth bass and channel catfish from Black Butte Reservoir are characterized separately as if people ate exclusively one species. This serves to show which species contributes more to potential health risks. The risks of consuming crappie and carp from Black Butte Reservoir cannot be characterized because the number of samples were inadequate (one composite each) to estimate and characterize the methylmercury level in populations of these fish species. One sample is not adequate for quantitative human health evaluation because by chance it could be unusually high or low (i.e., it could be in a tail of the distribution of the chemical in the fish population). Additional composites of these fish species should be sampled and analyzed.

Ingestion of largemouth bass contaminated with methylmercury poses the greatest potential hazard to consumers of sport fish from Black Butte Reservoir. HIs from eating largemouth bass suggest that even consumers eating only a few meals a month (i.e., low consumers) are potentially at increased risk. Average and high consumers are exposed at increasing multiples of the methylmercury reference level. Persons consuming high amounts of bass (e.g., subsistence fishers) are estimated to be exposed at more than ten times the reference level.

Ingestion of channel catfish contaminated with methylmercury also poses a potential risk to consumers of sport fish from Black Butte Reservoir. Low consumers of channel catfish are marginally at risk. But average consumers and high consumers eating channel catfish at the average mercury concentration would be exposed to increasing multiples of the reference level for methylmercury.

Although the risk characterization indicates that there are potential hazards associated with consuming largemouth bass and channel catfish from Black Butte Reservoir, it does not follow that consumers will show adverse effects. This is because the reference dose incorporates some margins of safety to account for uncertainties. Among all consumers, the subpopulation of greatest concern is the pregnant or lactating women, or women who might become pregnant who frequently eat large amounts of bass or catfish from Black Butte Reservoir.

**GUIDELINES FOR FISH CONSUMPTION**

On the basis of adequate data on mercury levels in largemouth bass and channel catfish, and likely consumption rates for these species, the risk characterization has shown that the methylmercury levels found in these species from Black Butte Reservoir consistently exceed the HI. Pregnant women and high consuming populations (e.g., subsistence fishers) should be informed of the potential hazards from consuming these sport fish from Black Butte Reservoir and should be especially aware of potential hazards to developing fetuses and children. These populations are advised to limit their fish consumption to reduce methylmercury ingestion to a level near the reference level. Generalized consumption guidelines can be established so that people can determine whether their personal consumption is above or below the reference level and decide whether to change their consumption accordingly. These guidelines for fish consumption are a science based communication tool useful for enabling sport fish consumers to reduce their potential hazards associated with consumption of chemically contaminated fish.

Consumption guidelines based on the number and size of meals that people can eat without exceeding the reference level can be related to tissue concentrations at the reference level. Table 5 shows the tissue concentrations corresponding to the methylmercury reference level at three different consumption scenarios: three meals per week; one meal per week; and one meal per month. When actual tissue concentrations fall within these ranges, consumers can use the corresponding consumption scenario to modify their consumption to an exposure at or below the methylmercury reference level. Using these guidelines for tissue levels in this table, it would be safe for pregnant women and children to consume one meal per month of largemouth bass (0.7 ppm mean tissue concentration) and channel catfish (0.4 ppm mean tissue concentration) from Black Butte Reservoir.

It is recommended that pregnant and nursing women, and women who may become pregnant within a year, eat no more than one meal of largemouth bass or one meal of channel catfish a month to protect them from the potential health effects of exposure to methylmercury as a result of sport fish consumption. This advice should also be followed closely by children under age six. This advice is based on the most sensitive population (fetuses and developing children). Older children and adults are also advised to follow these guidelines although their health hazards may be less. Concentrations of methylmercury similar to those in channel catfish were also found in a limited sample of carp and crappie from Black Butte Reservoir. Because the feeding habits of these three species are similar, there is good reason to believe that methylmercury concentrations in the population of carp and crappie will be similar to those in the well characterized channel catfish population. In this case, channel catfish are a suitable interim exposure model for consumption of carp and crappie and the same consumption advice to reduce potential methylmercury exposure should be applied to all three fish species.

**HEALTH ADVISORY FOR BLACK BUTTE RESERVOIR**

Due to the elevated level of mercury, pregnant women, nursing women, and women who may soon become pregnant (the most sensitive population) should eat no more than one meal (eight ounces) per month of largemouth bass, channel catfish, carp, and crappie. Mercury is a potent neurotoxin, so children and adults should also follow the same advice. Meal sizes may be adjusted to body weight using the information in Table 6.

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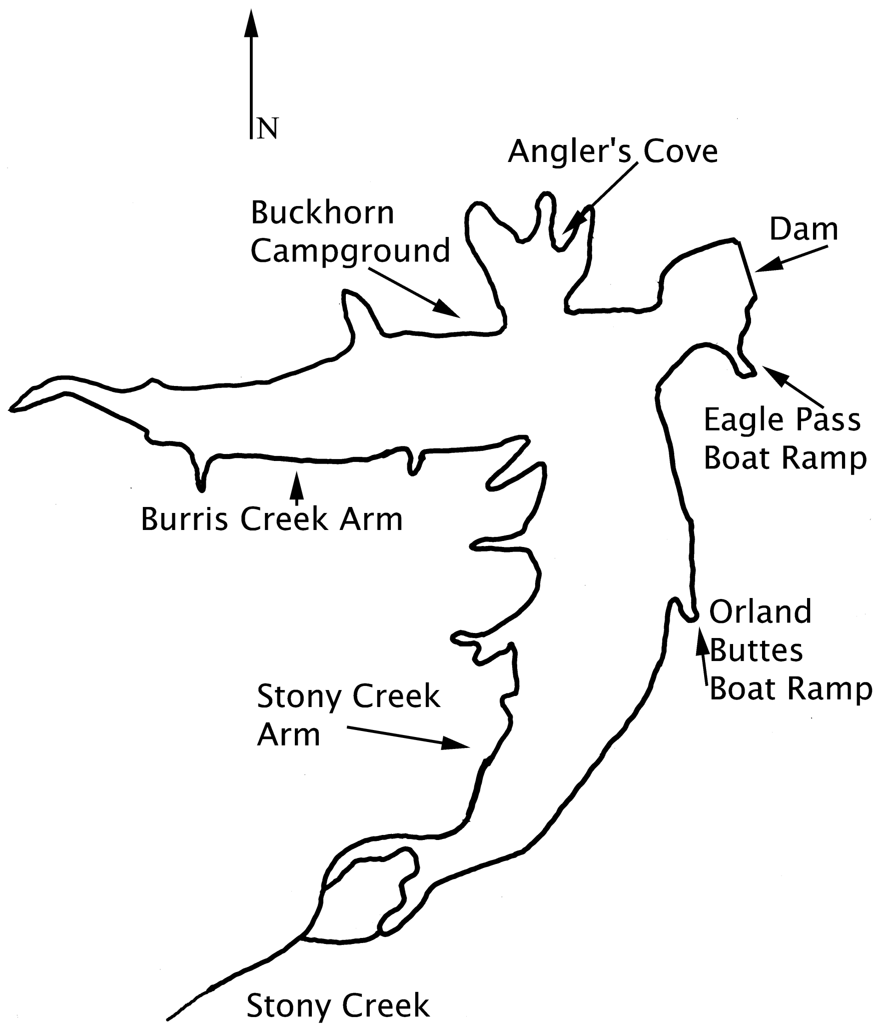
FIGURE 1: MAP OF BLACK BUTTE RESERVOIR AND COLLECTION SITES



## Table 1: Physical Characteristics of Fish in Composites from Black Butte Reservoir

| Composite | Fish per composite | Total length (mm) | Weight (gm) | Percent lipid | Estimated age (yrs) |
|---|---|---|---|---|---|
| | | | | | |
| Crappie-MS-A | 3 | 345 | 646 | 0.2 | 4 |
| | | | | | |
| Carp-AC-A | 3 | 478 | 1126 | 1.6 | 4 |
| | | | | | |
| Largemouth bass-AC-A | 3 | 503 | 2141 | 1.7 | 6 |
| Largemouth bass-AC-B | 3 | 402 | 960 | 0.3 | 4 |
| Largemouth bass-SCA-A | 3 | 372 | 716 | 0.1 | 4 |
| Largemouth bass-SCA-B | 3 | 312 | 398 | 0.1 | 3 |
| Largemouth bass-SCA-C | 3 | 308 | 388 | 0.2 | 3 |
| Largemouth bass-SCA-D | 3 | 302 | 384 | 0.1 | 3 |
| Largemouth bass-BCA-A | 3 | 507 | 2012 | 0.2 | 6 |
| Largemouth bass-BCA-B | 3 | 318 | 461 | 0.1 | 3 |
| Largemouth bass-BCA-C | 3 | 315 | 380 | 0.3 | 3 |
| | | | | | |
| Channel catfish-AC-A | 4 | 484 | 1016 | 2.4 | 6 |
| Channel catfish-SCA-A | 4 | 519 | 1227 | 2.3 | 7 |
| Channel catfish-SCA-B | 4 | 500 | 1142 | 3.8 | 7 |
| Channel catfish-SCA-C | 4 | 439 | 703 | 2.6 | 6 |
| Channel catfish-SCA-D | 4 | 426 | 647 | 1.8 | 5 |
| Channel catfish-BCA-A | 4 | 534 | 1460 | 4.9 | 8 |
| Channel catfish-BCA-B | 4 | 531 | 1382 | 3.0 | 8 |
| Channel catfish-BCA-C | 4 | 435 | 665 | 1.7 | 6 |

AC: composite collected from Angler's Cove
BCA: composite collected from Burris Creek Arm
SCA: composite collected from Stony Creek Arm
A, B, C, D: indicate different composites from the same area
Tabled values for length, weight, and percent lipid are the mean values for the fish in each composite.

**Table 2: Mean Chemical Concentrations in Fish from Black Butte Reservoir for which there are California Lakes Study Screening Values (concentrations in ppb wet weight except as noted)**

| CHEMICAL | Channel catfish | Carp | Crappie | Largemouth bass |
|---|---|---|---|---|
| | | | | |
| Chlordane | 2.6 | 2.2 | 0.5* | 0.8 |
| Chlorpyrifos | 0.4* | 0.4* | 0.4* | 0.4* |
| Total DDT | 13 | 9.3 | 2.2* | 4.4 |
| Diazinon | 12.5* | 12.5* | 12.5* | 12.5* |
| Disulfoton | LC | LC | LC | LC |
| Dieldrin | 0.4 | 0.3* | 0.3* | 0.3* |
| Total endosulfan | 3.2 | 3* | 3* | 3* |
| Endrin | 0.6* | 0.6* | 0.6* | 6* |
| Ethion | 7.5* | 7.5* | 7.5* | 7.5* |
| Heptachlor epoxide | 0.3* | 0.3* | 0.3* | 0.3* |
| Hexachlorobenzene | 0.1* | 0.1* | 0.1* | 0.1* |
| γ-hexachloro-cyclohexane | 0.1* | 0.1* | 0.1* | 0.1* |
| Toxaphene | 14 | 10* | 10* | 10* |
| PCBs as Aroclors | ND* | ND* | ND* | 2.2 |
| Dioxin TEQ (ppt) | 0.07 | NA | NA | 0.1 |
| Arsenic | 40 | 25 | 220 | 160 |
| Cadmium | 5* | 10 | 5* | 5* |
| Methylmercury | 400 | 300 | 340 | 700 |
| Selenium | 210 | 590 | 490 | 460 |
| | | | | |

*: all values below Method Detection Limit (MDL).
ND: Not Detected and there is no numerical MDL for Aroclors determined by this method.
LC: chemical lost on extraction column, no result.
NA: not analyzed for dibenzodioxins or dibenzofurans.
Shaded boxes indicate fish species for which the mean chemical concentration of the samples exceeds the SV.

## Table 3: Descriptive Statistics for Methylmercury Concentration in Largemouth Bass and Channel Catfish

| Composite | Methylmercury concentration in ppb | Size of fish in composite | Descriptive Statistics |
|---|---|---|---|
| | | | |
| | | | |
| Largemouth bass-AC-A | 1100 | Large | Mean: 700 ppb<br>Standard deviation: ±360<br>Median: 530 ppb<br>Geometric mean: 628 ppb<br>Skew: 0.86<br>Kurtosis: -1.12 |
| Largemouth bass-AC-B | 700 | Medium | |
| Largemouth bass-SCA-A | 590 | Medium | |
| Largemouth bass-SCA-B | 470 | Small | |
| Largemouth bass-SCA-C | 430 | Small | |
| Largemouth bass-SCA-D | 410 | Small | |
| Largemouth bass-BCA-A | 1300 | Large | |
| duplicate | 1200 | Large | |
| Largemouth bass-BCA-B | 370 | Small | |
| Largemouth bass-BCA-C | 440 | Small | |
| | | | |
| | | | |
| Channel catfish-AC-A | 420 | Medium | Mean: 400 ppb<br>Standard deviation: ±56<br>Median: 380 ppb<br>Geometric mean: 398 ppb<br>Skew: 0.63<br>Kurtosis: -0.91 |
| Channel catfish-SCA-A | 350 | Large | |

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| | | | |
|---|---|---|---|
| Channel catfish-SCA-B | 370 | Large | |
| Channel catfish-SCA-C | 380 | Medium | |
| Channel catfish-SCA-D | 350 | Medium | |
| Channel catfish-BCA-A | 500 | Large | |
| Channel catfish-BCA-B | 460 | Large | |
| duplicate | 440 | Large | |
| Channel catfish-BCA-C | 340 | Medium | |
| | | | |

## Table 4: Methylmercury Concentration, Exposure Dose and Hazard Index for Fish from Black Butte Reservoir

| **Concentration level / consumption rate** | **Largemouth bass** | **Channel catfish** |
|---|---|---|
| | | |
| **Methylmercury concentration in ppb wet weight** | | |
| **Mean** | 700 | 400 |
| | | |
| | | |
| **Daily exposure in mg/kg/day x10$^{-4}$** | | |
| Low consumption 21 g/day | 2.3 | 1.3 |
| Moderate consumption 50 g/day | 5.4 | 3.1 |
| High consumption 107 g/day | 12 | 6.6 |
| | | |
| | | |
| **Hazard Index (HI) ratio of daily exposure compared to methylmercury reference level (unitless)** | | |
| Low consumption 21 g/day | 2.3 | 1.3 |
| Average consumption 50 g/day | 5.4 | 3.1 |
| High consumption 107 g/day | 12 | 6.6 |
| | | |
| | | |

## Table 5. Guidelines for Tissue Levels at the Methylmercury Reference Level

| Chemical of Concern | 3 Meals/Week "General advisory" (97.2 g/day) | Meal/Week (32.4 g/day) | Meal/Month (7.5 g/day) | No Consumption |
|---|---|---|---|---|
| Methylmercury (ppm) | | | | |
| pregnant women/fetuses/children | <0.07 | 0.07-0.20 | 0.21-0.87 | ≥0.88 |

NA: Not applicable

The recommended level for consumption of fish contaminated with a non-carcinogenic chemical such as methylmercury is below or equivalent to the chemical's reference level. People could eat more fish with a lower tissue concentration (before they exceed the reference level) than fish with a higher concentration. The following general equation can be used to calculate the fish tissue concentration (in mg/kg) at which the consumption exposure from a chemical with a non-carcinogenic effect is equal to the reference level for that chemical at any consumption level:

$$\text{Tissue concentration} = \frac{(\text{RfD mg/kg - day})(\text{kg Body Weight})(\text{RSC})}{\text{CR kg/day}}$$

where,

| | | |
|---|---|---|
| RfD | = | Chemical specific reference dose or other reference level |
| BW | = | Body weight of consumer |
| RSC | = | Relative source contribution of fish to total exposure |
| CR | = | Consumption rate as the daily amount of fish consumed |

This equation was applied above to determine tissue concentrations of methylmercury in sport fish that would be below or equivalent to the chemical's reference level when eating different amounts of fish. The U.S. EPA RfD of $1 \times 10^{-4}$ mg/kg-day was used as the reference level. A body weight of 65 kg was used to represent an average weight of pregnant women during gestation. It was assumed that fish represent 100 percent of the source of methylmercury to a fish consumer.

**Meal Sizes used in this table:**

Although people eat different meal sizes, their typical portion size is related to their individual body weight in a fairly consistent manner (see Table 6). The standard portion size eaten by an average adult (body weight 70 kg or 154 pounds) is eight ounces (227 g) (U.S. EPA, 1994). People tend to remember how many meals of a specific food they eat in a month and this interval is often used in consumption surveys (Gassel, 1999). A standard portion of one fish meal a month is equivalent to $7.5 \times 10^{-3}$ kg/day, one meal per week is equivalent to $3.24 \times 10^{-2}$ kg/day, and three meals per week is equivalent to $9.72 \times 10^{-2}$ kg/day.

## Table 6. Adjusting Fish Meal Size for Body Weight

| Body Weight | | Meal Size | |
|---|---|---|---|
| **pounds** | **kilograms** | **ounces** | **grams** |
| 19 | 9 | 1 | 28 |
| 39 | 18 | 2 | 57 |
| 58 | 26 | 3 | 85 |
| 77 | 35 | 4 | 113 |
| 96 | 44 | 5 | 142 |
| 116 | 53 | 6 | 170 |
| 135 | 61 | 7 | 199 |
| 154 | 70 | 8 | 227 |
| 173 | 79 | 9 | 255 |
| 193 | 88 | 10 | 284 |
| 212 | 96 | 11 | 312 |
| 231 | 105 | 12 | 340 |
| 250 | 113 | 13 | 369 |
| 270 | 123 | 14 | 397 |
| 289 | 131 | 15 | 425 |
| 308 | 140 | 16 | 454 |

 

**APPENDIX 1**

# INTERIM FISH CONSUMPTION ADVISORY FOR BLACK BUTTE RESERVOIR

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# Interim Fish consumption Advisory, Black Butte Lake

**The Office of Environmental Health Hazard Assessment (OEHHA) of Cal/EPA has tested the fish from Black Butte Lake and has determined that they contain mercury at a level that may require a fish consumption advisory. Since OEHHA will not be able to complete it's advisory until sometime next year, the Glenn County Health Department is providing this interim fish consumption advisory based on a State advisory from Clear Lake, where mercury levels in the fish are similar. Bass species other then largemouth bass should be consumed at the same rate for equal sized largemouth bass. Catfish species other then channel catfish should be consumed at the same rate for equal sized channel catfish. Fish not listed should be consumed at the same rate as small crappie. Note that the fish consumption advisory finally published by OEHHA for Black Butte Lake may differ from the Clear Lake advisory.**

**Almost all fish, whether commercial or sport are contaminated with some level of mercury. Mercury is a naturally occurring element in Coast Range rock formations. Similar levels of mercury contamination in fish flesh have been found in many Northern California lakes and reservoirs. Following the consumption guidelines in this advisory provides a safe way to catch and enjoy your favorite sport fish.**

## CONSUMPTION RECOMMENDATIONS for CLEAR LAKE

1.Eating sport fish in amounts slightly greater than what is recommended should not present a health hazard if only done occasionally such as eating fish caught during an annual vacation.
2.Nursing and pregnant women and young children may be more sensitive to the harmful effects of some of the chemicals and should be particularly careful about following the advisories. Because contaminants take a long time to leave the body after they accumulate, women who plan on becoming pregnant should begin following the more restrictive consumption advice, a year before becoming pregnant. In this way, the levels of chemicals stored in the body can go down.
3.The limits given below for each species and area assume that no other contaminated fish is being eaten. If you consume several different listed species from the same area, or the same species from several areas, your total consumption still should not exceed the recommended amount. One simple approach is to just use the lowest recommended amount as a guideline to consumption.

**Clear Lake (Lake County)**
Because of elevated mercury levels, adults should eat no more than the amounts indicated below per month (See Note No. 3 above). **Women who are pregnant or may become pregnant, nursing mothers, and children under age six should not eat fish from these lakes.** Children 6-15 years of age should eat no more than one-half the amounts indicated for adults.

.

| FISH SPECIES | CLEAR LAKE ADVICE |
| --- | --- |
| largemouth bass over 15" | 1 lb |
| largemouth bass under 15" | 2 lbs |
| channel catfish over 24” | 1 lb |
| channel catfish under 24" | 3 lbs |
| Crappie over 12” | 1 lb |
| Crappie under 12” | 3 lbs |

Adjusting Fish Meal Size for Body Weight

In the site-specific guidance that follows, OEHHA often gives consumption advice in terms of meals for a given period such as a meal a week, and uses an eight-ounce meal size as the standard amount allowed for the "average" adult. The average adult weighs approximately 150 pounds (equivalent to 70 kg). Because you and your family members may weigh more or less than the average adult, you can use the chart below to adjust serving sizes to stay within the recommended consumption guidelines.

**How big is a meal?**

| IF YOU WEIGH… | | YOUR MEAL SIZE SHOULD NOT EXCEED | |
|---|---|---|---|
| Pounds or | kilograms | Ounces | or grams |
| 19 | 9 | 1 | 28 |
| 39 | 18 | 2 | 57 |
| 58 | 26 | 3 | 85 |
| 77 | 35 | 4 | 113 |
| 96 | 44 | 5 | 142 |
| 116 | 53 | 6 | 170 |
| 135 | 61 | 7 | 199 |
| 154 | 70 | 8 | 227 |
| 173 | 79 | 9 | 255 |
| 193 | 88 | 10 | 284 |
| 212 | 96 | 11 | 312 |
| 231 | 105 | 12 | 340 |
| 250 | 113 | 13 | 369 |
| 270 | 123 | 14 | 397 |
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November 2, 1999

**NEWS RELEASE**

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Cal EPA's Office of Environmental Health Hazard Assessment recently released the results of a fish study in Black Butte Lake. The study included chemical sampling of 57 fish taken from the lake in November and December of 1997. Analysis of the fish showed that the levels of organic chemicals (including PCBs, dioxin and some pesticides) are not a concern. However, the analysis also showed that fish from Black Butte Lake have somewhat elevated levels of mercury in their flesh. Even low levels of mercury in the diet are a concern because mercury can have an adverse affect on the neurological development of children. Higher levels of mercury are toxic to the nervous system of adults.

Almost all fish whether purchased commercially or caught as sport fish contain mercury. Mercury is a widespread contaminant in California lakes and reservoirs, especially in the coast range where there are naturally high levels of mercury in the rock formations. The average level of mercury encountered in Black Butte lake fish was lower then the federal action level for commercially marketed fish (one part per million), but similar to levels of mercury in sport fish from other Northern California lakes where fish consumption advisories were published by the state. The levels of mercury in Black Butte Lake fish are close to levels found in fish from Clear Lake. The state does not anticipate completing a risk analysis and consumption advisory until next May. Since eating fish from Black Butte Lake could represent a hazard to the public, the Glenn County Health Department has adopted the Clear Lake Consumption Advisory as an interim fish consumption guidance document.